solplan review

the independent newsletter of energy efficient building practice

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INSIDE . . . .

We are beginning to hear much about automated buildings. The desire to take advantage of new technology is why the smart home may be the area where much new residential technology development takes place. We review what that automated home is all about, and also raise a few questions about what and why work to develop automated homes.

Ventilation of unheated crawlspaces is needed to ensure the durability of the building structure. We review a case study of a mechanical venting scheme of an unheated crawlspace, and review a suggestion for an alternative way to vent crawlspaces.

A national program to recognize jobsite innovations has been launched. The program is described, and the first winner of the program is presented.

Wood-electric combination heating systems are being seen more often now, especially in rural areas. We present the findings of an evaluation on one such system that is being promoted by a B.C. wood stove manufacturer.

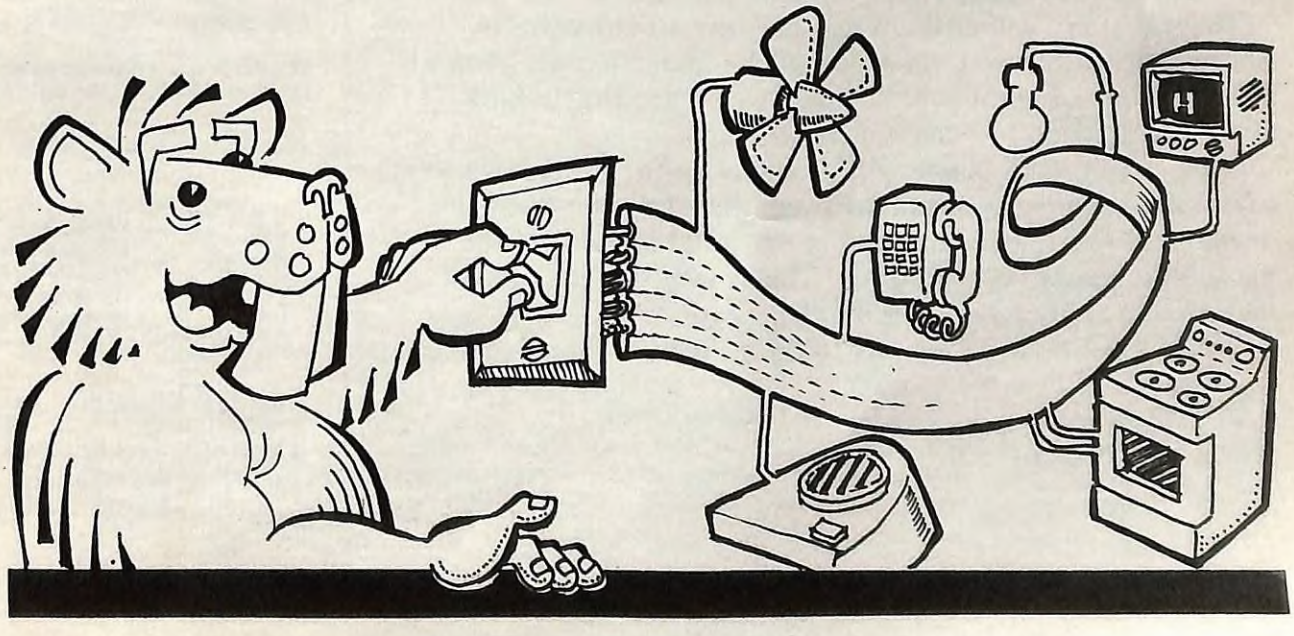
Codes and regulations are made based on a risk assessment of the consequences of the use of the different products and techniques. Just how that is done is an art form, but we should be aware of the thinking, as it will affetr all builders.

Other items include a summary of the findings of a survey of R-2000 homeowners; a description of a new wall system, and a variety of news briefs.

CONTENTS

The Intelligent House 3
Crawlspace Ventilation 5
Job Site Innovator Awards 7
Wood-Electric Heating System 8
Risk Assessment 10
R-2000 Homeowner Survey 12
New Products: Super Lok Solar Wall 14
Odds 'N Ends 15

THE INTELLIGENT HOUSE



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Richard Kadulski

FROM THE PUBLISHER

With this issue we begin our fifth year of publication. In the short time we have been at it, we have seen several other publications fold. As a business, it's marginal, which may explain the failure rate. However, it is still a enjoyable to prepare each issue.

There was a void in the information system in the construction industry. When we started SOLPLAN REVIEW, it was to fill this void. In recent years, programs such as R-2000 have spurred much valuable research and innovation, but what is being developed or discovered is not always getting out to the field. That is the niche we saw and which, in our modest way, are trying to fill. Unfortunately, too few people in the industry even bother to keep informed (yes, we still need more subscriptions).

The need for better education never fails to show up. It was stressed recently when I was called on to recommend remedial action for a new residence in Vancouver. The problem was caused by sloppy work and cost cutting. Basic building practices for good quality construction were not followed.

The house had not gone through a full winter before leaks and water seepage through fireplaces and under the floor were detected. Within a few months, the floor structure was a holding tank full of water, the loose fill insulation soggy. The whole thing was a mess. Needless to say, when more than 600 square feet of finished hardwood and subfloor has to be ripped up, the owner is unhappy (he had no way of knowing what he was getting into).

Important construction details were changed from the original design drawings. While the unit was slapped together, the finishes were top notch (as the sales and marketing types would say, "it had great curb appeal"). Never mind that the structure wouldn't last. That's a minor point.

The sad thing is that there was no need to cut corners. Because of its location, the value of the house is well over $1 million even though it's quite small, so we are not talking about low budget, low margin construction.

Who should take blame will probably be for the courts to say; there are many players involved, including the project developer. The important thing is that what should be the exception happens all too often. This is why quality control issues continually creep into building regulations.

There must be a better way to do it. But how?

Richard Kadulski
Publisher

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Editor-Publisher: Richard Kadulski
Illustrations: Terry Lyster

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Tel: 604-689-1841 FAX: 604-689-1401

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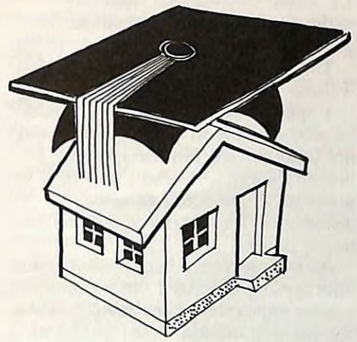
R2000 design evaluations
HOT2000 analysis

richard kadulski architect

#205 - 1930 west broadway
vancouver, b.c. v6j 1z2
telephone (604) 689-1841

THE INTELLIGENT HOUSE



The desire to develop new housing systems that take advantage of new technology has been around for some time. Various schemes are being worked on to take create fully automated or intelligent homes a reality.

The intelligent house is one that takes advantage of new automation technology to provide for the homeowner a safe, efficient, automated home. In the intelligent home, appliances and mechanical systems are controlled by a central communications module.

Some home automation products are already available. The Japanese are beginning to produce a wide range of products that have the capability of automated management. The European community has its own project underway to investigate options to take.

The SMART HOUSE project in the USA (and which has received a fair bit of publicity already) has been underway for several years, and a prototype is expected to be built soon.

Why Home Automation?

There is one essential question that is not getting much consideration. Just because we have the technical ability to produce a fully automated home, is there a convincing need for it?

We may well have the technical ability to create a fully automated home. It is the outcome of the technology development that has happened in recent years, especially in the communications field.

What are we going to gain by building automated homes? Will they be more comfortable? more healthy? more durable? safer? cheaper? or is it the latest toy of a society that is preoccupied with gadgets, toys and gimmicks?

There is also a potentially sinister issue related to automated buildings. As the wiring systems involve two way communications among all appliances and the master controller for management purposes, there is a concern for the privacy in the home. The possibility exists for outside sources to monitor what is going on in the house.

The simplest example is that the cable company can monitor how many TV sets are plugged in and operating, and watching what stations. If you have signed up for one set, but are using three, they can catch you.

On a more serious level, your phone lines can be tapped more easily than at present. As all appliances are hooked up, you every move can be monitored. With more use of two way communications, and talk of interactive television, it may be difficult to turn off a listening device even when you want to have some privacy.

Sounds a bit like the scene set out of George Orwell's novel **1984** where Big Brother is watching you, doesn't it? The potential for abuse exists, and it is an abuse that only large corporations or governments that could afford to take advantage of.

We don't mean to be paranoid or to put down the concept of the automated home, but there has not been much discussion yet about what the consequences are or about the need for it in the first place.

Recently the affordability of new homes has become a concern, as we realize that there is an ever growing sector of the population that has difficulty of getting into a house. How is the automated home going to help?

The only way that development costs of the new technology can be recovered is to pass them on to the consumer. So the automated home will mean a more expensive home. Will the added cost be offset by the greater value of the home? Can an automated home be built affordable enough to be a starter home? Are the automated systems themselves simple to operate and durable?

We are already seeing the impact of new automation in the automobile industry. Even though the new auto technology is more reliable, the cost of repair work is many times that of the older technology conventional vehicles (your friendly corner mechanic just doesn't have the skills to deal with it). They may be a pleasure to run, but a disaster if they break down.

There is no doubt that the basic concept of the automated home can be fascinating, and that it can provide a better quality home. However, fundamental questions must be asked, and we have not seen them asked yet.

As you read about the general thinking behind the automated house, keep these questions in mind. We leave to the reader to make a judgement of whether or not this is the direction in which housing research and development should be pursued.

What is an intelligent house?

The central component of the intelligent house is the wiring. At present, homes use a variety of cable systems: standard line-voltage AC power; low-voltage wiring for doorbells, thermostats, light switches and alarm systems; TV wiring; speaker and phone wiring. Each line is separate, strung out like spaghetti throughout the house. You can only plug the appliance that belongs to its outlet.

The intelligent house uses new wiring concepts to use a single cable system that will provide power, control data signals, and provide audio, video, and phone signal distribution. In other

words, any outlet could be used for any appliance. The wiring operates on the principle of a closed loop.

Closed Loop Wiring

In closed loop wiring, the outlets do not become live until there is a call for power. Each appliance generates a signal that tells the system master control what kind of appliance it is (radio, power tool, heater, washing machine, etc), and it's energy requirements. The system master control (a computer chip not unlike the ones in pocket calculators) then sends energy though the circuit to the appliance.

This kind of system requires a special multi-purpose cable, and special fittings on each appliance so that the system can respond to the appliance. If this kind of approach becomes a reality, new appliances will be equipped with appropriate fittings (adaptors would be made for existing conventional appliances to make them compatible).

The significant feature of the system is that the outlets are not continuously live as they are now. So that if a child sticks a piece of metal into the plug, it will not get a shock as the system will not recognize the object, and so will not provide power to the socket.

How does the system work?

The controller

The system works on the principle of a closed loop, with two way communications, and power available only on demand.

The house is basically set up as a single circuit, and power is doled out to the appliance that calls for electricity at that instant only. The controller knows what the total load is at any given instant, and allocates power to the appliances as they call for it and will not allow overloading of the system. Usually, there are some appliances that will have a lower priority that others, so their power can be offered in bursts, between the call for others or on a pre-programmed time of day operation.

As the control responds to signals, any device able to send the right signal can be used to control any appliance regardless of where it is located. Cable TV would be available from any outlet, just as a phone could be plugged in anywhere.

The control system also means that if there was a problem sending energy to a specific appliance, energy would be shut off only to that appliance and not to all others. However, even though energy would be shut off, messages could continue to be distributed through the signal line (as to the phone).

As all controllers handle energy and information, messages can be sent among appliances. For example, when the washing machine has finished its cycle, it could send a message to your TV to flash a message on the screen to let you know. If the doorbell or phone rings, it can shut down the vacuum so that the ring can be heard and answered.

Characteristics of the smart home

* Compatibility among all appropriate components
* reduced electric shock and fire hazards
* more, easier communication, automation, home security and personal health applications
* less costly metering and monitoring of utilities
* increased flexibility for new appliances and functions without additional wiring
* flexibility of control

The system does not prescribe how or what each appliance will do. Rather, it will offer the means for doing whatever the designers want it to do. It will offer manufacturers the opportunity to develop new ways of doing things, including flexibility in design and performance.

On a more serious level, this type of technology offers the potential for assistance for the disabled, ill and elderly. Sensors to monitor motion, body heat, respiratory sounds and even spoken requests for help are being developed. These could be plugged in, with a minimum of added expense. The house controller would then be programmed to direct the messages where required, either to other parts of the house or outside (office, hospital, or emergency services).

The fully automated control offers the potential to gain the maximum energy efficiency for the home's operating systems. Instead of having to provide 200 amps (or more) for a house it may be possible to do it with a much smaller feed, as there is power sharing between the appliances, so it is not necessary to have live circuits throughout the house. This will be of help to utilities do power supply management.

Typically we have to provide a system sized on the chance that a variety of appliances may be hooked up simultaneously, to avoid overloading the system. But how often are all the appliances and lights on at any one time? Even when you are cooking breakfast or supper, the toaster, coffee maker, and oven or range will only be on for a few minutes in a given period. Many heating appliances actually cycle, in other words then are not operating at peak power all the time, but in bursts.

The controller would thus administer the power delivery to each appliance, so that even if by chance you managed to plug in more than the total system capacity, the controller would administer power delivery to the appliances as needed to so that you do not overload the circuits.

Compatibility

The smart house concept requires all appliances to have some form of interchangeable communication interfaces. A fully functional smart house will allow all household appliances (regardless of manufacturer) to talk to each other. The various automated home systems that are being developed have to decide how they are going to deal with the issue of compatibility among different components made by different manufacturers. Once a uniform standard is developed and accepted, then manufacturers can produce equipment that is compatible among them.

For example, look what happened to TV video equipment (have you tried to use a SONY remote control on your SANYO VCR?) It don't work too well, does it? In a smart house, it would not matter which manufacturer's components you have, you should be able to mix and match.

The compatibility issue is going to be major stumbling block to be overcome. At the moment, the US **Smart House** project is being handled as a proprietary product - in other words only those companies that been accepted by the partners (and have bought into the project) will be allowed to use the standard for their products.

The development work on the SMART HOUSE in the USA is taking a long time to get off the ground. It is being done through a joint venture of a number of major utilities and manufacturing companies, with the coordination of the National Association of House Builders (NAHB).

It is not unlike the BETA VCR that was developed by SONY. It is a system that belongs to SONY, and they are the only ones producing equipment. The major competitor is the VHS system that was licensed to all who wished to use it (and which now has probably 80% of the total video market - even SONY is now producing VHS equipment).

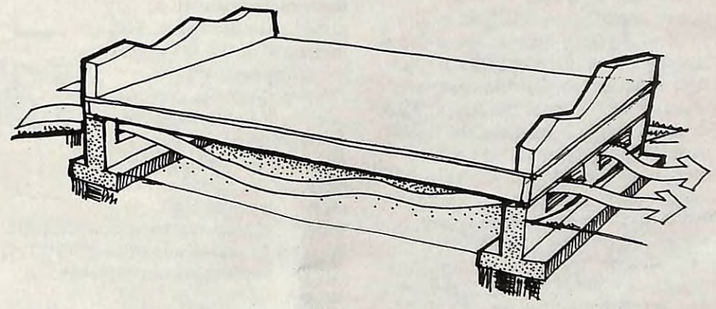
Canadian Automated Building Association

Recently, a Canadian Automated Building Association has been established to provide a focal point in Canada for all parties interested in promoting the development, application and utilization of electrical, electronic and other advanced technologies related to automated building systems and services in the residential, commercial, industrial and institutional sectors.

The objectives of the Canadian organization are to ensure that systems, technologies, codes, standards, and other regulatory requirements are compatible, to provide forums for all interested parties to talk to each other during the development of standards and programs required to introduce products and technologies to the Canadian market; to demonstrate automated buildings, and to encourage Canadian industries to develop new business opportunities.

Richard Kadulski

CRAWL SPACE VENTILATION



Crawl spaces are complicated building zones that bridge the gap between conditioned space and the exterior. Many factors influence the conditions to be found in the space.

As crawlspaces are a part of the foundation system, the structural durability of the floor joists is critical for the life of the building.

Moisture, decay and insect infestation are the major problems associated with crawlspaces. Where they are insulated, heated crawlspaces seldom are a problem (they need not be vented outside, as some inspection authorities seem to insist on). It is the unheated, vented crawlspaces that can be sources of trouble, especially if the construction was not done properly in the first place.

Moisture and warm temperatures create ideal conditions for growth of mould, fungi and insects in organic materials. In other words, warm moist wood creates ideal conditions for all the nasty stuff that deteriorates frame buildings. (Remember that warm to

bugs and fungi is not necessarily the same as for humans.)

Is this a common problem? Wet crawl spaces have always been reported. The main sources of moisture are ground water, seeping or wicking up through the concrete, exterior surface water finding its way into the space, and interior water vapour migrating into the space and condensing on colder surfaces. Usually, it is a related to poor construction practices and inadequate attention to detail.

Placing a ground seal such as poly, on the floor of the crawl space will drastically reduce ground water migration up through the concrete into the crawlspace. It will not, however, deal with any bulk ground water seeping into the space through cracks and gaps in the foundation.

The main requirement for moisture control is crawlspace ventilation. The National Building Code requires that there be an unobstructed vent area of .1m^2 for each 50m^2 of floor area. It further states that vents for crawl spaces must be uniformly distributed on opposite sides of the building to allow for cross ventilation, reducing the possibility of stagnant air pockets.

But even if there are more vents than the code calls for, will there be enough air flow? To move air the crawlspace must be warmer than the outside, or wind must be blowing the air through the space.

Until recently, especially in milder climates, the floor over an uninsulated crawlspace was often not insulated or underinsulated, so that the space was indirectly heated from the space above. As we use more insulation, the crawl space becomes more of an exterior space, but shielded from the extremes of the outside environment. This means that surfaces will be colder, and relative humidity will be higher.

For timber structures, the moisture content of wood is critical. If it is over 20%, the potential for mould and insect damage increases.

A recent survey of moisture, decay and insect infestation in residential crawlspaces by the Bonneville Power Adminstration found that ventilation in larger quantities or a total lack of ventilation appears to reduce moisture problems.

Mechanically vented crawlspace

A recently built townhouse project in Vancouver was designed in a manner that made it difficult to provide open ventilation on opposite sides on each unit's crawlspace. After much consideration, the builder opted for a partial mechanical system.

The crawlspace is positively pressurized by a continuous airflow of prewarmed outdoor air at a rate of about 20 cfm (Average floor area was 800-900 sq.ft. per unit). In order to verify the effectiveness of the ventilation strategy, the project was monitored. The moisture content of the rim joist and sill plate were measured at intervals.

What was found? Unfortunately, the measurements of the moisture content were not done in a consistent manner, nor were the same units measured each time.

However, there is enough data to suggest that the lumber was not getting the chance to dry out. Between April and November 1988, readings hovered between 16-20%. While there was a slight drying (about 1-2%) it did not seem to be doing the job as visible wet spots were noted after one year.

It suggests that there was inadequate ventilation provided to the space. The insulation in the floor above the crawlspace kept exposed materials cooler, offering ideal surfaces for moisture condensation. The temperature difference between the space and the exterior was not high enough to generate natural convection currents to create adequate ventilation, and the mechanical air flow was not enough.

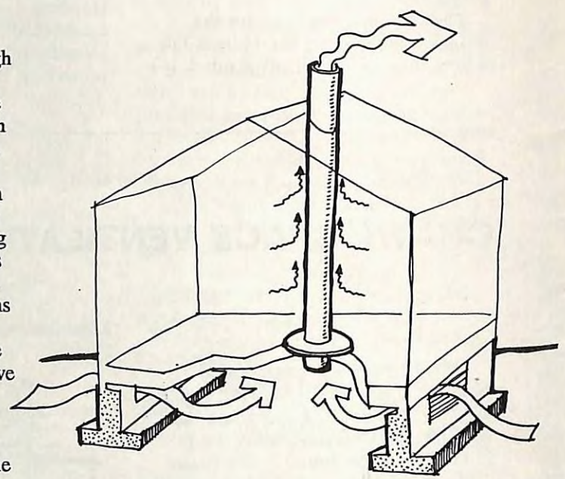
It may seem that a long hot summer should provide good drying conditions. In fact the opposite is true. Winter air is cold and dry, with little moisture, and will quicken the drying process.

During the summer, a crawlspace is cooled by the thermal mass of the ground. Warm exterior air (which will contain a large amount of moisture), is cooled as it is brought into the crawlspace, loosing its ability to hold water. Moisture will condense on any cool surface it comes in contact with. It's the same thing that happens when you pour that tall cool summer drink. Condensation forms almost at once on the exterior of the glass.

In very drafty houses during cold weather the entire house acts like a chimney. Warm air escapes through openings in the upper part of the house, to be replaced by cold air finding its way in through the lower parts of the house, including the crawlspace. The cold air moving through the crawlspace helps keep it dry.

Alternative Crawlspace Venting Strategy?

We have heard the following idea for passive venting of crawlspaces from several sources. On the surface it seems like a reasonable alternative.



The suggestion is that a sealed plastic vent pipe (3-4" diameter) be placed through an interior partition, open at the bottom into the crawlspace, and out through the roof. No part of this pipe is open to the interior. Theory suggests that the warm house will generate a stack action in the pipe and generate air flow up, thus creating a draft that will ventilate the crawlspace.

This may be functional idea. However, we can't forget that cold glass on the table in a warm room. The cold air flowing through the vent cools the pipe, allowing condensation to happen on the vent, thus creating a moisture problem inside the house.

Is this a situation of solving one problem but creating another?

We welcome comments from readers who may have seen this type of installation.

Richard Kadulski

JOB-SITE INNOVATOR AWARDS PROGRAM

A program to encourage builders and tradespeople to develop and share new construction "tricks-of-the-trade" or techniques has been set up by Canada Mortgage and Housing Corporation. The goal is to make house construction or renovation easier, faster or more cost effective. Cash prizes are provided.

The contributor of the best "job-site innovation" of the year as judged by representatives of CMHC and CHBA, will receive travel expenses to attend the Home Builders Association annual convention to receive recognition by way of an "Innovator of the Year" award.

What is a "job-site innovation"?

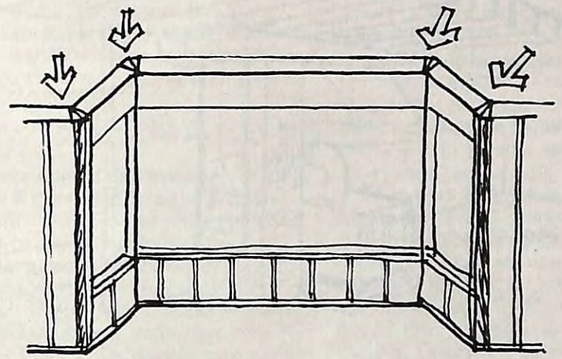
It is any new construction method or technique which is immediately transferable to others in the building industry, without their having to purchase special equipment or products.

An innovation is most likely to qualify for an award if it:
- is an on-site demonstration of a new idea,
- is an easier, faster or cheaper way to do a job,
- provides an economical solution to an on-site technical problem,
- seems likely to attain wide general use by builders, renovators and tradespeople,
- produces results acceptable under the provisions on the National Building Code of Canada, CMHC'S Technical Builders Bulletin, minimum property standards for existing residential buildings and provincial or municipal regulations.

1988 Innovator of the Year

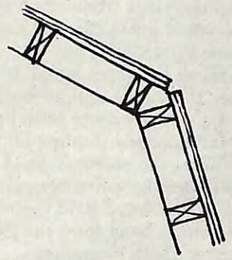
The first national "Innovator of the Year" Award was presented this year to John Church of United Properties Ltd. of Vancouver, B.C. at the CHBA convention in Hamilton, Ont.

The innovation was for a detail for framing corners greater than 90°.



The Problem

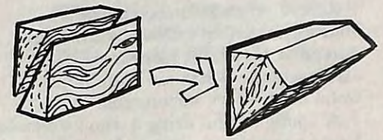
Framing and finishing of corners greater than 90°, such as those found in bay windows, poses a problem. Due to the angles involved, these corners generally do not have any blocking to support the exterior sheathing edges. The can cause siding to cup and stucco to crack at these unsupported corners.

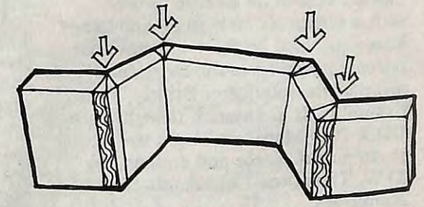


The Innovation

1. When framing, make sure that the top and bottom plates are mitred precisely to the required angle, and that the mitred corner is plumb from bottom to top plate.

2. Rip a stud diagonally, at the appropriate angle. Turn the pieces around so the "points" touch and nail together.





3. At United Properties, these corner pieces are pre-cut. The framer nails them together and installs them in the walls. The cost of doing this job is more than offset by a better job and less callbacks for cracking of interior and exterior finishes.

To find out more about the Job-Site Innovator Awards Program or to offer your idea, contact your local CMHC or Canadian Home Builders Association office.

WOOD-ELECTRIC HEATING SYSTEMS

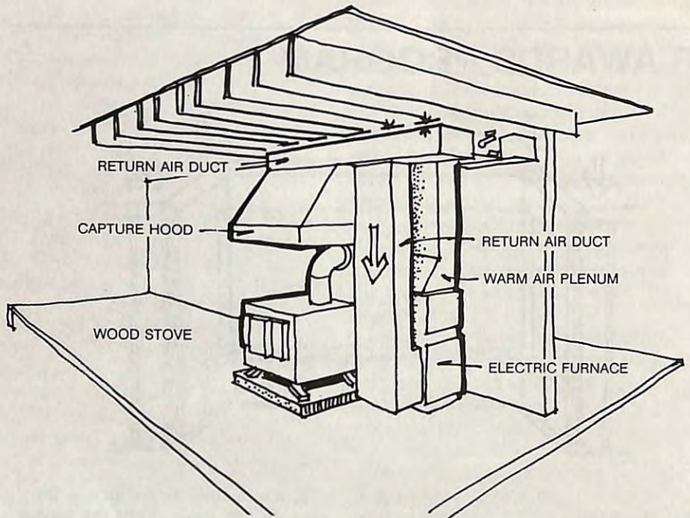


Figure 1 Wood/Electric combination heating system

Recent years have seen many innovative heating systems put to use. A regular forced air furnace which also circulates warm air heated by a wood stove is not uncommon.

A configuration using a wood stove located next to an electric furnace, with a return air pick-up to circulate heat generated by the wood stove has become common in the more rural areas of the interior of British Columbia. It is a system thought up by Black Pine Manufacturing a wood stove manufacturer and designed by D.W. Thompson Consultants, both of Kamloops.

The system has not had any safety problems but concerns were raised that led to a design and performance review. Canada Mortgage and Housing Corporation commissioned a field study to evaluate the safety (for occupants) of the heating systems and to suggest alternatives to improve performance.

The System

Typically a wood stove is located next to an electric furnace, both located in the basement. (fig. 1) A capture hood above the wood stove is placed to pick up warm air and place it into the return air flow of the furnace, to circulate warmed air to heat the house.

The design illustrations do not show a separation between the return air plenum and the joists from which it is hung. This would mean that the joists would be subject to the same temperatures as the sheet metal. If the system were to be operated as gravity fed (due to a power outage or to by occupants intentionally shutting off the electric furnace) the plenums could overheat and thus be a fire hazard. Most installations noted have the return air plenum hung from the joists with at least a 2 inch clearance.

In all cases the installation must adhere to code and fire safety regulations. Some of the installations examined in this study were not according to code, either because of improper clearance to combustibles, or improper location of combustion air ducts and flues.

Hood Design

The height and shape of the capture hood can vary. If sufficiently large, it will capture close to 100% of the warm air rising from the wood stove. However, if the furnace blower is not operating, the warm air will spill. The hot air rising off the wood stove must exceed the velocity of the air being removed from the capture hood.

Location of appliances

The wood stove and electric furnace were always located side by side in basement rooms. In most cases the appliances were in an unpartitioned basement, and were not isolated from other rooms in the house. If a furnace room were to be built around the two appliances, it would drastically change the flow patterns and pressures through the house, creating imbalances between supply and return air, increasing the potential for combustion gas spillage and chimney backdrafting of the wood stove.

If the wood stove were located on the main floor of the house, it would eliminate all concerns raised by this type of heating system. The furnace blower could still be used to circulate warm air. However, many homeowners prefer the basement location for the wood stove (it seems to keep the ashes and dirt away from the living space).

Controls

A thermostat is located in the capture hood and wired to the furnace, so that the furnace blower will operate the furnace at high speed to distribute the heat. The location of the thermostat can be altered, but the temperatures vary depending on the location (by 20°C or more) during operation. This means that once the thermostat is installed, it must be calibrated to ensure that it works properly.

The thermostat trip temperatures must also be set. The design guidelines suggest a setting of 35°C, although field observations noted trip settings as high as 53°C. This would cause a delay in the start up of the circulation blower, and a premature shut down of the blower. Improper settings can lead to excessively high plenum temperatures and could contribute to a fire hazard.

Return Air Transfer Grills Between floors

For optimum operation, cold air transfer grills allow supply air from the main floor to return to the capture hood in the event that the basement door and stairwell is closed off. However, these transfer grills are considered a fire hazard by fire officials, and would not be permitted in most new homes.

Unfortunately, eliminating transfer grilles may increase the chances of an unbalanced system, making the wood stove more likely to spill and backdraft.

Householder operation

The heating system is not always operated according to design. The home owner may shut down the electric furnace, to use the wood stove as the only heating system, thus preventing the furnace blower from circulating warm air. Because of the high plenum temperatures and poor performance of the system when the blower is not used, this is not advisable.

Field observations noted that some homeowners did shut off the furnace.

The concerns

Concerns about the system which justified a detailed evaluation and consideration include:

* Will maximum temperatures developing at the floor joists cause a fire hazard before or after the circulation fan is tripped?
* Is the potential for backdrafting of the wood stove increased because of the large return air hood?
* Will high return air temperatures passing through the electric furnace put excessive wear on electrical components and possibly trip high limit switches?
* If the system is operated without the blower (e.g. during a power outage) will the gravity fed plenum temperatures become a fire hazard?

The study tests focused on measuring air temperatures in and around the system, air flow, air patterns through the system and backdrafting limits on the system.

Temperature monitoring was designed to record maximum temperatures created during a 2-3 hour hot burn. Air temperatures were measured at the capture hood thermostat, surface of the return air duct next to the floor joists, and in the return air plenum just at the furnace.

Backdrafting limits of wood stoves

Tests showed that operating at a low burn, 8 Pascals of house depressurization was needed to cause the wood stove to spill around the stove pipe.

A temporary furnace room assembly (to test what would happen if the owner were to subdivide the basement and create a separate furnace room) showed that it was depressurized at a pressure of 16 Pascals just by operating the electric furnace blower. This was enough to cause backdrafting from the wood stove during a low burn operation. This happened even though the furnace room had a 4" diameter combustion air duct into the room. When the combustion air duct was plugged up, it didn't make any difference to the pressures.

Even with a combustion air feed direct into the wood stove, and gasketed doors, backdrafting potential exists through the stove pipe joints (they can't be caulked or taped as they have to be cleaned regularly).

Modifications Suggested

An improvement to this system would be to limit the amount of return air being drawn in through the hood by properly sizing the connecting opening between the hood and return air plenum. At the same time, a supply grille of equal size should be cut into the supply air plenum directly above the electric furnace.

To prevent high plenum temperatures in the return air plenum (especially when the blower is not operating) a duct leading from the top or side of the capture hood should drop down about 3 feet below the hood before entering the return plenum. This would avoid hot air captured by the hood from entering the ducts until the blower was running.

Richard Kadulski

The study on which this item is based was prepared for Canada Mortgage and Housing Corporation by Sheltair Scientific Ltd. of Vancouver.

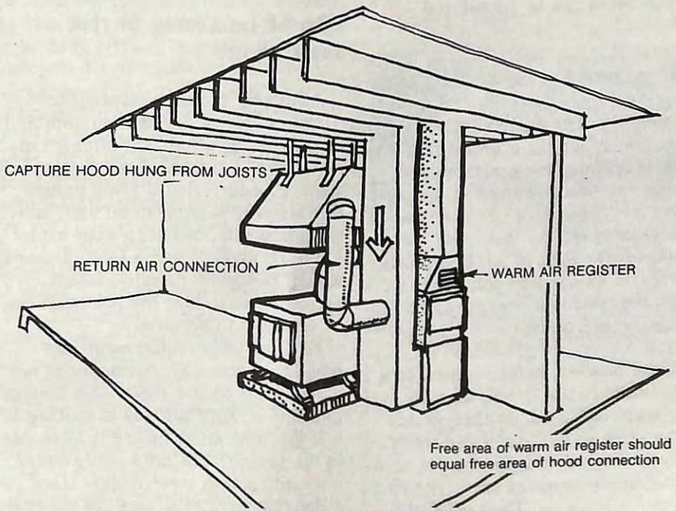

CAPTURE HOOD HUNG FROM JOISTS
RETURN AIR CONNECTION
WARM AIR REGISTER
Free area of warm air register should equal free area of hood connection

Figure 2 Wood/Electric combination heating system
Suggested alterations

RISK ASSESSMENT

Every day we make decisions. Most of the time we have a good idea of the outcome of any action taken, so we don't spend much time thinking about the risks involved. Only if the activity or product is new to us, we may spend more time evaluating the possible consequences.

Making an accurate assessment of the risk involved is an art. Every time a builder quotes on a new job he is weighing the risks involved.

While this may seem like a philosophical topic, removed from the real world, you should be concerned. Every regulation in the Building Code and in standards is based on a variety of factors, including an assessment of the risks associated with the use of a given product or technique.

The intent behind mandatory requirements must also be kept in mind. Fundamentally, it is for health and safety considerations. Quality concerns and how people may use or abuse property must be kept in mind, but do we have to build to protect people from themselves? What level of user education can be considered reasonable?

What is risk assessment?

Making the best judgement to reduce potential risks is an art that is based on reasonable expectations of the outcome of a given action. Before you get into a plane or car you have to be reasonably certain that it will take you where you want to go. If you find that it is on its last legs you may have second thoughts and may even decide to look for alternatives.

If you are presented with a new structural product, before you make a commitment to use it, you want to make sure that it will do the job that it's supposed to do; that it will safely carry the loads that are to be put on it.

Insurance companies are in the risk assessment business. They regularly look at what they are going to insure and make a decision about the probability of an event happening. Based on their estimate of the circumstances they decide if they are going to write a policy, and how much they will charge for it. If they consider an activity or item has little danger associated with it, the premium will be less than one that has higher risk.

Factors that have to be assessed include the inherent safety of the product. Is it structurally sound? Will it offgass or make the environment unhealthy? If it fails, will it do so in a safe way?

Estimating the risk associated with various activities is a key consideration in the code and regulation making process.

Why be interested in risk assessment?

All design decisions, especially structural design, involves an appraisal of the risks involved. The strength of materials is known and assigned a value. Consideration is given to how that material is likely to be used in a given structure, including what loads are to be applied, and a safety factor is added. Designers have to make a prediction as to how the materials can be expected to perform.

Building code requirements are made the same way. Assumptions are made about what a reasonable margin of safety is. Another way of looking at it is just how much failure is allowable in the system? We can usually tolerate a condition with some danger if we judge that the risk is small as the cost of avoiding all risks may be too high. Estimating the risk associated with various activities is a key consideration in the code and regulation making process.

If we know that 60 or 70 deaths per year are a result of the failure of a system, how much are we willing to spend to avoid them? How much trouble will it be to avoid all harmful conditions, compared to just most of them?

If we are proposing a new measure, the consequences must be known. How many deaths can be tolerated if it will cost $100 or 200 million to avoid any? Is one incident of cancer that can be prevented tolerable, if the cost of ensuring it is avoided runs in the hundreds of millions of dollars?

Extreme? Not really. This is the type of thinking that must be followed in making decisions on new mandatory measures.

Proposed revisions to the National Building Code have a potential cost of hundreds of millions of dollars, with unknown savings. Of special interest are proposed changes for radon mitigation, fire safety, and security. Think about the implications of each of these.

Residential sprinklers

Residential sprinklers are being promoted by fire departments (and obviously the manufacturers). The cost is estimated to be about $1 per square foot. For the typical house today that could mean around $2-3000 extra.

Not considered in this cost estimate are the offsite implications. Sprinkler systems require minimum quantities of water flow, so community systems may have to be upgraded, or made larger. This could be a problem in some communities.

But is this expense worth it? There are no statistics to tell us what proportion of fatalities due to fire happen in new housing compared to old. This is important, as the quality of construction and materials used today are much different from older housing stock. If it is the older, poorly maintained buildings that are firetraps, including sprinklers in new construction won't do anything to reduce fire deaths.

Proponents suggest that insurance rates would be lower if a home were sprinklered. So far, best premium reduction we have heard about is 15%. As a typical policy may run $300-400, that is not much of an argument. Insurance companies are also concerned that accidental water damage may do more harm than the fire! (One even charges an extra supplement for homes with sprinklers).

What about alternatives? If safety of the occupants is an issue, can something else be done to prevent them? In B.C. there has only been one fire death noted in a situation where a smoke alarm was installed and in working condition. Unfortunately, the evidence is that 30% of detectors are not maintained.

Where deaths in fires were recorded, lifestyle considerations were a major factor. Typically, the person was a smoker who had been drinking prior to falling asleep with a cigarette.

The question to be asked is how much do we build in to protect people from themselves? At what point do we say that everyone has to take a degree of responsibility for their own actions? If someone is likely to light candles on a dry Christmas tree, and it catches fire, what do we do? Do we have to re-write the code to provide a sprinkler to control a fire, or do we try to let people know that it is a stupid thing to do, and encourage them not to or they will pay the consequences?

Sprinklers do a good job. But must they be mandatory? Their use should be encouraged because of their value, but on a voluntary basis.

Radon Abatement

In recent years we have become aware that homes can have high levels of radon. No one is completely certain just what is a safe, acceptable level of radon, but it is known that high levels increase the chances of lung cancer.

A complicating factor is that radon is a naturally occurring element (not a by-product of some industry). In addition, it's presence in a house is not readily predicted. The only thing one can say is that if you are located in an area whose geology indicates radon rich soils, you might have to worry about it. Just because your next door neighbour has high radon levels, does not mean you will.

Because radon is a concern in some areas, there is a change coming in the 1990 revision of the National Building Code that will require homes to be built so that will be easy to retrofit. The implication is that someone will do a test at some time in the future to see if radon is a problem, and if it is a problem, then some remedial work will be done. (Just don't ask who is going to do it, when or how).

The major provisions are good building practice - to pay attention to details and sealing of the basement. But it will also require a layer of coarse gravel under the basement slab, so that *if* radon is detected, sub-slab suction can be introduced. This requirement will apply to all areas, regardless of local geological history. This will add to the cost. Is it justified?

Crime Prevention

Most petty crime and burglaries (90% of residential break-ins) are carried out by casual or non-professional burglars. In other words, by kids and others who take advantage of an easy mark. If someone can get into your house easily, they may take advantage of the opportunity.

Police forces have pointed out that if reasonable security provisions are taken, then the number of break ins drops dramatically.

In B.C. changes were made in the last round of code alterations. The B.C. Code now requires that exterior doors have deadbolts with a minimum 1" throw, hinges be installed with long screws, main entry doors must be provided with a security peep hole, and solid blocking must be provided at both sides at lock height. There are also requirements for locks on ground level windows. All commonsense items. All have a cost attached to them.

Just because burglaries are a problem in Vancouver, Toronto or Montreal, does every little town and rural property have to be built like the city fortress? Is it justified to require tight, secure buildings everywhere?

Consistency

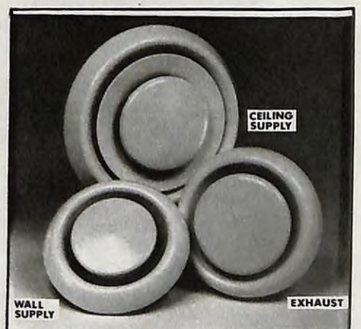
How consistent are we going to be? Smoking has been proven to have a high mortality and costs associated with it. We know that there are high risks associated with it, yet we have not outlawed it, and in fact we tolerate smoking.

By regulation we are proposing to impose a cost to society of hundreds of millions of dollars to prevent and avoid death and injury which may be caused by a building product, construction technique or occupant lifestyle. How do you weigh what is an acceptable casualty rate?

We seem to be rushing into regulating some elements in building construction (for a good reason on its own), but we don't do anything about much more lethal byproducts of other activities, be it smoking fatalities, or chemical pollutants generated by industry. How much are we willing to spend to reduce some of these fatalities?

There is no easy answer to any of these questions. They are some of the concerns that have to weighed when we make decisions about any course of action.

Richard Kadulski



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R-2000 HOMEOWNER SURVEY

The R-2000 Program was set up with specific objectives, goals and a timetable. It was primarily designed to improve the energy efficiency of Canadian housing.

The program's initial emphasis was on the energy features, and included technology transfer and builder education. Fortunately it was recognized early that if changes were going to be made to housing, then all aspects of the house were going to have to be considered, as a house is a complete system. You can't isolate one feature without it having some impact on other portions of the house.

The original phase of the R-2000 program included direct federal government participation (along with the Canadian Homebuilders Association) in the adminstration of the program. That phase is now winding down, and the industry in each province and territory is picking up the program and making it run.

The value of the R-2000 program, however, must not be lost in the maze of administrative detail and numbers games about how many houses have been registered within the program. The significant impact is that the program has had, and will continue to have, a major impact on the way housing is being built in this country and abroad.

Because there was concern that specifications and innovations be technically valid, many of the R-2000 houses were carefully monitored. The monitoring data represents an important housing data bank. Many of the surveys and monitoring projects not only looked at the specific innovations in the R-2000 houses but also looked at houses built by the housing industry in general, which were used as a "control" group.

Homeowner Surveys

We can instrument a house and come up with all manner of detail about its physical operations, but we also need to know if it makes any sense to the resident. After all, the object of housing is to provide shelter for people in which they will find it a joy and pleasure to live. As any realtor can tell you, technical features alone are not enough.

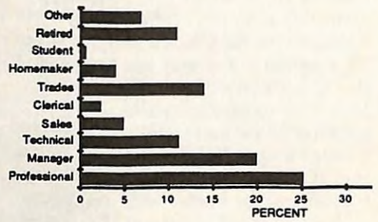
To determine occupant reactions, a number of homeowner surveys were made. The object of these were to:
* determine the effectiveness of the R-2000 technical specifications
* establish the energy savings
* provide information on indoor air quality and heat recovery ventilator performance
* identify areas requiring improvements or changes
* assess occupant satisfaction
* obtain marketing information on occupants.

The homeowner surveys were done in two phases. The first phase examined the original 300 demonstration houses which represented the builder's first attempt at working with the R-2000 standard. These surveys were done mostly in 1983 and 1984. The second phase surveys included homes built to revised technical criteria, and were carried out between 1985 and 1987.

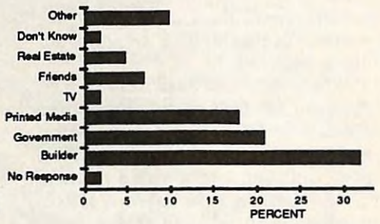
The surveys were detailed and included follow up visits. The results provide an insight into who buys R-2000 homes and why. They also present occupant impressions after they have lived in the house for some time (and the novelty has worn off), as well as identifying common concerns and areas of satisfaction.

Who bought R-2000

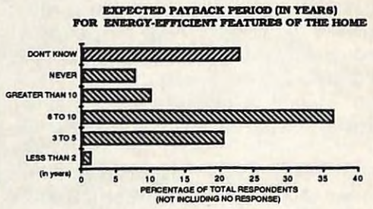
The image of the R-2000 house as the status symbol for Yuppies is confirmed.
* The owners were mostly between 31 and 45 years old
* Most were "professionals"
* Most had two income earners (57%)
* Most were "move-up" buyers who had owned a detached home before
* Almost half of the homes had two adults and children, while one third were occupied by childless couples.



What influenced the buying decision?



Many factors affect a home buyer's decision to buy.
* Information provided by the builder was the most significant
* government information
* print media (much of this would have been government funded).
* size/design of the house



The energy efficient features of the R-2000 houses were important considerations. There was acceptance of the extra initial cost for the long term benefits. 23% of the homeowners expected a payback period of 5 years or less. As well, 23% did not know what the payback term was - or perhaps they didn't care.

What is the owners' attitude after living in an R-2000 home?

The majority of homeowners considered the energy features to be positive, and felt the energy savings were being achieved (only 5% believed that savings were not attained).

Perceived Advantages and Disadvantages to Living in an R-2000 Home

	Perceived Advantages	Perceived Disadvantages
Indoor Air Quality	• Less Dust • Less Moisture • Humidity Control • Fresh Air	• Air Too Dry • High Humidity • Stale Air
Thermal Comfort	• Warmer • No Drafts • Constant Temperature	• Overheating • Cold Basements
Noise	• Quieter	• HRV Noise • Loud Furnace
Other		• Electricity Costs

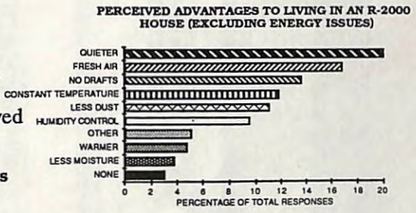
The survey identified perceived advantages and disadvantages of living in an R-2000 home. The format of the survey was such that the issues were suggested by the homeowner - they were not suggested by the survey. The three most important features of an R-2000 house identified were: the indoor air quality, they are quiet, and the thermal comfort.

The questions and responses were solicited both in the survey conducted shortly after the owner occupied the home (when they could have been influenced by claims made by sales information) and in the follow-up survey which would reflect actual experience.

Almost one half perceived no disadvantage to living in the homes.

The most commonly reported disadvantages were HRV noise, dry air and high electrical costs. The main indoor air quality problem was dry air in the winter (identified by less than 10%). Relatively few homeowners (less than 15%) specified any air quality problems.

The significant information is how perceptions change over a year or more of residence in the house.



After living in the house for at least one year (in the initial phase), there was a small change, as some homeowners found high humidity and HRV noise as a problem but the net change was small (less than 10% of the total).

Noise generated by the HRV and forced air heating system were identified by the second phase survey as major problems.

Major indoor air quality problems identified by 12% was dry air. The relative humidity must be considered in conjunction with climatic conditions, occupant lifestyle and the difficulty in defining the sensitivity to dry air. Many of these responses came from areas where higher relative humidity is the "norm". This also indicates a problem of over-ventilation.

The increasing concern of excessive ventilation means that some people are shutting off their HRV's. However, the survey noted that 90% ran their HRV continuously, the balance at least part of the time. Half also indicated they ran their HRV during the summer as well.

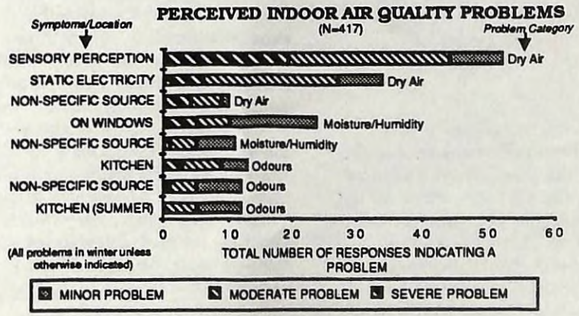
The issue about ventilation rates, as regular readers know, is one that still has not been fully resolved. We still hear from builders about homeowners shutting off their ventilation because of the perceived dryness of the air. Whether this problem is real or more a perception will maybe require more study.

Overall, homeowner satisfaction is very high. Only 4% indicated they would not purchase again, while 11% did not know.

While these surveys were done in order to document the performance of R-2000 homes which have received much publicity, and involve technology innovation, it is too bad that a parallel survey of owners of standard market houses was not done at the same time, as was the case for technical issues.

Richard Kadulski

This is based on 'Results of the R-2000 Homeowner Survey' prepared for the R-2000 Home Program by Buchan, Lawton, Parent, Ltd.

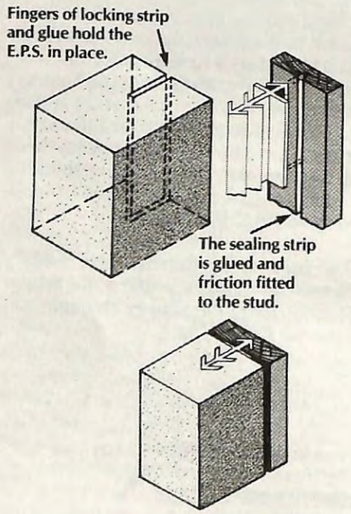


NEW PRODUCTS: THE SOLAR WALL

In recent years we have seen a number of new manufactured wall systems come on the market. The NASCOR wall manufactured by Cano probably has become the major, most visible producer. However, there are many others that are working on alternatives, each in their own way addressing the shortcomings of the other guys on the block.

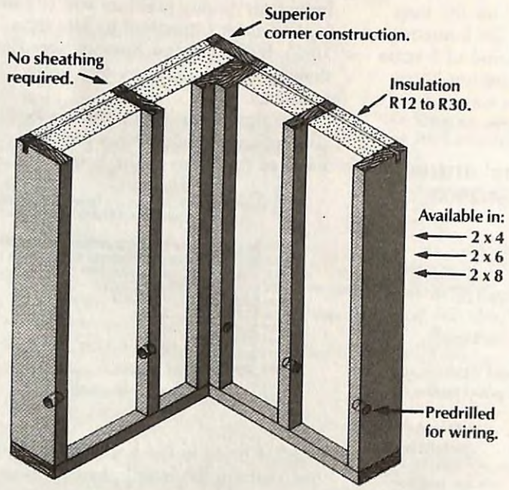
What sets this system apart?

Recently a new system has been developed in Langley, B.C. The unique element in the system is a locking strip that is used when the panels are assembled. The strip is glued and friction fit into the EPS foam and studs/plates to create an airtight panel.



Inherently, the system is very airtight. The major weak spot in the system is the joint between adjacent panels or the sill plate, which do not benefit from the premanufactured locking strip. However, a simple caulking bead should provide the required sealing at that point.

A second advantage to the system is that by design, the foam is kept back from the face of the studs, to create a cavity in which services are run. The major problem encountered on the jobsite with systems where the foam is finished flush is how to deal with services. We have seen many instances where by the time the electricians and plumbers were finished hacking the foam to get their conduits and piping, one begins to question the value of the system.



Built-in Rain Screen

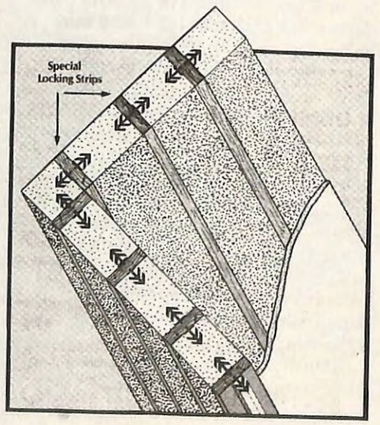
The manufacturer is fine tuning the system. A refinement that is being planned is a modification to the system, to set back the outside face of the foam, thus creating a cavity on the outside as well. This would be especially beneficial where siding is used. In this way the system would automatically create a compartmented cavity that is necessary for the rain screen principle. The stud projections automatically compartment the face of the wall, ensuring a functional rain screen. (SOLPLAN REVIEW no. 18)

The major shortcoming of this system is the thermal bridging through the wall studs, which are solid kiln dried wood.

The major value of rigid foam wall systems is that the foam blocks are resistant to wind flow, so that air currents can't establish themselves within the wall. This reduces the potential for heat losses by convection. By reducing the potential for convection, heat losses are reduced. Convection currents can establish themselves in lose, porous fibrous type insulations, especially those not installed properly. This air movement can be a major source of heat loss.

What about costs? As with some of the other prefabricated wall systems, their cost may be a bit more than site assembled, stick framed construction. However, if the system performance, durability, compatibility to design, quick assembly and availability is considered, it may in many cases be worth the initial extra cost.

Information:
Super Lok Ltd.
Box 3031
Langley, B.C. V3A 4R3
Tel: 604-576-6611



ODDS 'N ENDS

Rigid Foam Insulating boards

The decision by the province of Ontario to ban the use of products which are manufactured using chlorofluorocarbons (CFC's) will mean that unless the production process is changed, extruded polystyrene board (Dow Chemical's Styrofoam is just one brand) will no longer be available by July 1, 1990.

For the sake of the environment this is a positive step. But this will affect everyone who uses these products. They are very good for their proper applications, and suitable alternatives are not always available. No doubt the manufacturers will be looking at alternate production methods.

Foam plastics are often lumped into one class. It must be remembered that expanded polystyrene (EPS - also often referred to as beadboard) is not foamed with CFC's but uses steam. EPS does not have the same properties as extruded polystyrene. Water absorption by beadboards and polyisocyanurates is much higher than the extruded boards, which means that for some applications, such as below grade, beadboard is not a suitable material.

ELF's

No, this is not an item from your child's bedtime storybook. Rather, it is the acronym for a new Window Rating system that is being developed in Ontario. The letters stand for Energy Loss Factor. The object of the system is to provide consumers with a yardstick by which they can make purchasing decisions, with some assurance that the claims are not overstated.

While the units for the ratings will be in watts/square metre, they should be considered like the automobile mileage ratings - giving a relative indication of window performance. The performance rating is going to be a derived number, from a formula that includes window air leakage, thermal performance (R-value) and solar shading.

The formula is being refined at the moment, and should be ready for use within the next few months.

Drywall Discolouration Update

Work is carrying on to find the source of the problem of drywall discolouration.

It appears that in the last year most paint formulas have changed as a result of a world wide shortage of titanium dioxide, which is a key component of the hiding agent used in most paints. It has been suggested that this may be a contributing factor.

It seems that the problem is not as serious when oil based paints are used.

Residential Sprinklers

Even though the 1990 edition of the National Building Code has not yet seen the light of day, work has started already on the 1995 edition. A major concern is the mandatory requirement for residential sprinklers. (See SOLPLAN REVIEW No. 22)

Because of the enormous effect on the cost of new homes, CHBA has stressed the need to do a proper assessment of the impact of sprinklers. A CMHC financed study is presently underway. Preliminary indications are that sprinklers may not be as cost effective as alternative approaches.

New Blowing Wool from Fiberglas Canada Inc.

Loose fill glass fibre insulation must be fluffed up in order for it to be used. Because too many customers specify a certain depth of insulation (rather than an R-value), there has been much abuse in the field. It is not uncommon for insulation installers to cut costs by using less material, fluffed up to a given depth (although few will admit that it happens).

Without admitting that this may be a real field practice, Fiberglas Canada is changing their formula to make it harder to misuse the material. The new version of blowing wool that is not vulnerable to over fluffing will be available soon.

HRV Material Safety

Residential heat recovery ventilators are built from 2 basic materials: metal and plastic. Every manufacturer claims his products are the best, and will go to great lengths to justify their claims. Some manufacturers have stressed the importance of the material, suggesting that as plastic is flammable, those units are not safe.

Metal based HRV manufacturers went so far as to produce a full colour poster showing a burning plastic core, the suggestion being that will happen to all plastic core HRVs.

The move was taken in the hopes of generating support against a code change that clarifies that combustible materials in residential HRVs (air flows under 400cfm) are acceptable. But that did not happen, and the code change is going ahead.

The concern for non-combustible components arises out of requirements that exist in commercial buildings, where air flow volumes and duct sizes are very large, and flammability of materials is a major concern.

It is too bad that these kind of scare tactics have to be taken. Although plastic may be flammable, there are many safeguards in the system that reduce the probability of a fire breaking out. It is unlikely that the temperature in the HRV core would even reach ignition temperatures, as the fan would cut out (and with it the source of oxygen) long before the fire could break out.

There are many other elements in a house that have to be considered, such as the continuous operating fan in the furnace, which can move large quantities of smoke around the house long before a major fire breaks out.

The question is: what is the nature of the problem? What are the acceptable margins of safety? Codes and standards must reflect the materials and attainable construction practices in the field.

Surely the metal core HRV manufacturers should be able to promote their products on the inherent merits of their unit designs.

Quality Plus

The new low energy home program that will continue the R-2000 program in B.C. will be launched April 2, 1989. It will be administered by CHBA-BC. Co-sponsors include B.C. Hydro, The New Home Warranty Program of B.C., and B.C.Gas.

LEBCO SYMPOSIUM: June 19-21, 1989

Plans are proceeding to make the coming conference an excellent opportunity to discuss and deal with the concerns of healthy and safe energy efficient house.

The Environmentaly Clean, Energy Efficient Building: the problem defined: a medical perspective; an occupant's point of view; the builder's viewpoint; how to achieve a clean building; the material's; builder's viewpoint; mechanical equipment; design issues; filtration of air;

Other items include a presentation by B.C. Hydro of their energy management programs, and over 90 technical papers covering all aspects of low energy construction issues, as well as photovoltaics, low head hydro and other renewalbe energy issues.

Pre-conference sessions will include an R-2000/Quality Plus Home Builder workshop; Small Hydro design workshop; and a Photovoltaic Design Workshop

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